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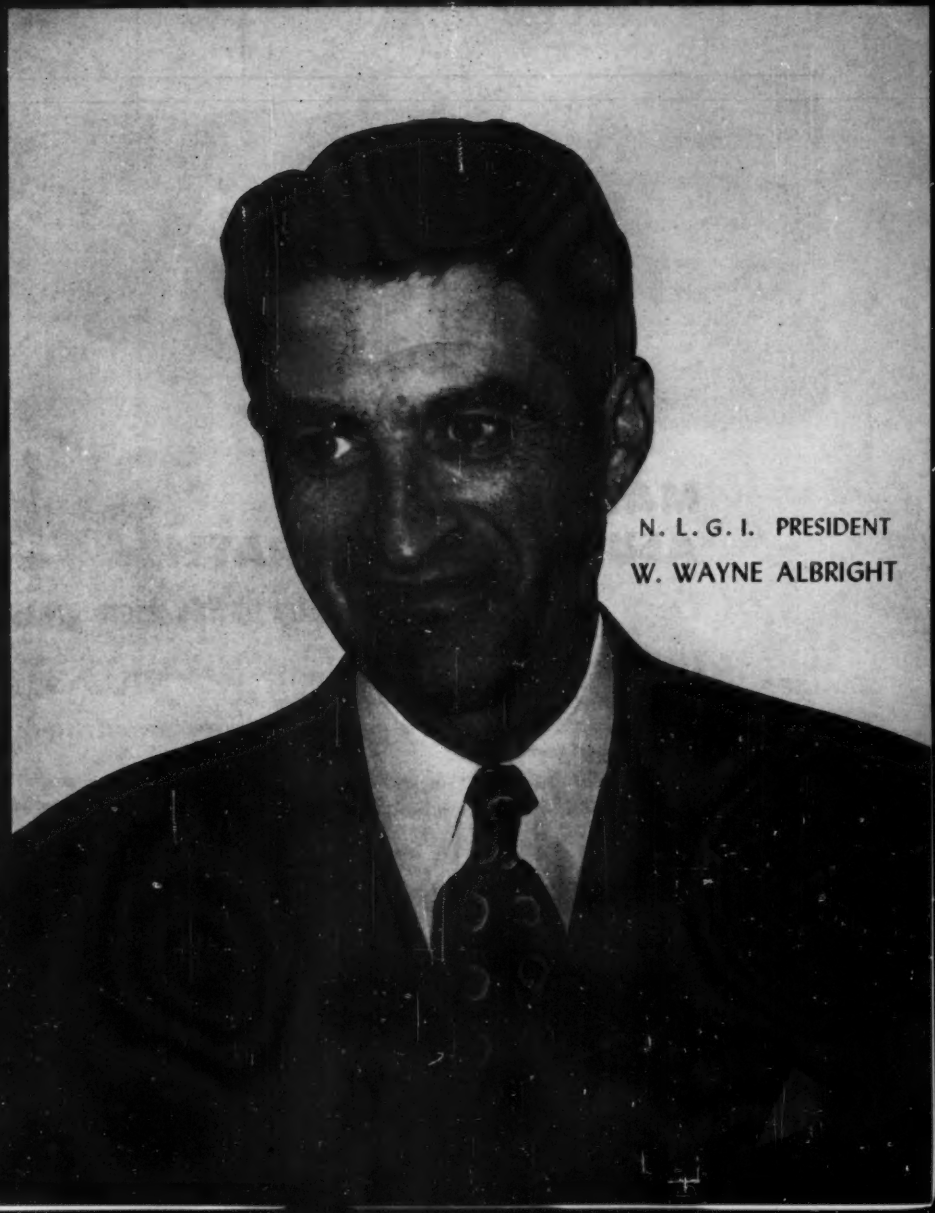

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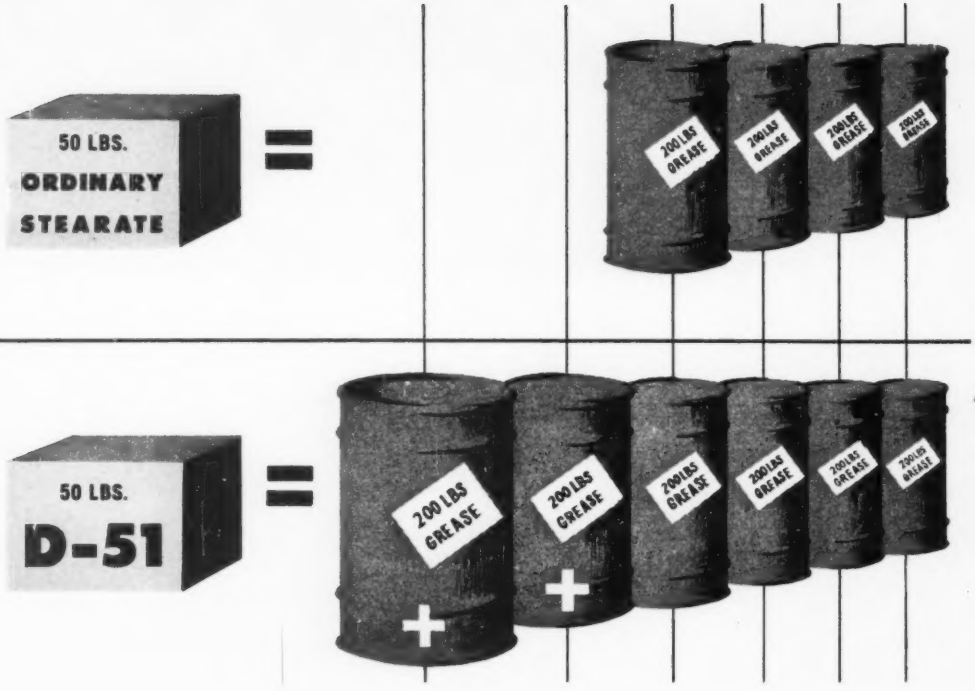

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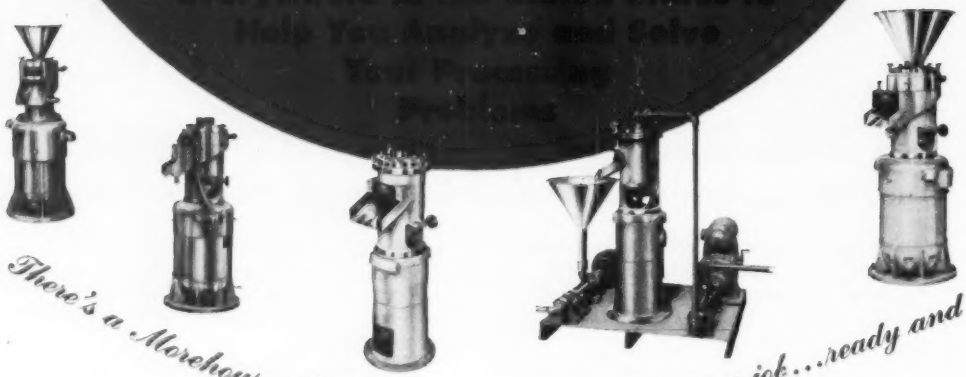

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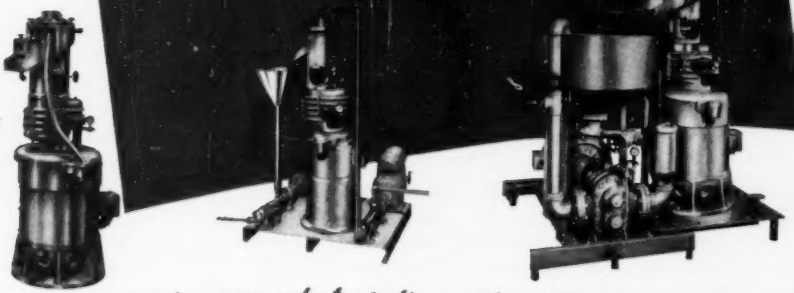

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Published monthly by
The National Lubricating Grease Institute
Harry F. Bennetts, *Editor*
Joanne Couey, *Assistant Editor*
4638 J. C. Nichols Parkway
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1 Year Subscription.....$2.50
1 Year Subscription (Foreign).....$3.25

The INSTITUTE Spokesman

Volume XVI Number 8 November 1952

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ABOUT THE COVER

At the 20th Annual Meeting of the National Lubricating Grease Institute, W. Wayne Albright, Assistant Manager, Lubricating and Sales Technical Service Department of Standard Oil Company (Indiana), Chicago, was unanimously elected president. The largest N L G I Annual Meeting in history was held at the Edgewater Beach Hotel, Chicago.

Mr. Albright received a Bachelor of Science degree in chemical engineering at the University of Michigan in 1922. Later he joined Standard Oil Company (Indiana) as a member of the company's first sales engineering school. Until 1926, when his service was interrupted approximately one year, he was a lubricating engineer in the Sales Technical Service Department in Chicago. In 1927, he returned to the company as a lubrication engineer at Detroit.

Mr. Albright was in the sales department until 1937, when he became a lubrication engineer. In 1946, he was made assistant to the manager of the Lubricating Department at Chicago. Mr. Albright became Assistant Manager, Lubricating and Sales Technical Service Department, Chicago, in 1948, and continues in this position.

With residence in Flossmoor, Illinois (Chicago suburb), Mr. Albright is married and has a family of two sons and one grandson. His hobbies are "Standard Oil", golf and bowling.

President's page

by W. Wayne Albright, President, N L G I

NLGI PROGRESS

The National Lubricating Grease Institute is now twenty years old. The magnitude of its growth and accomplishments can be evaluated in many ways.

The most noteworthy recognition of this Institute was an award received from American Trade Association Executives which presented us with its Grand Award this year. It is especially significant that this award is presented to that trade association rendering the greatest service to its members and the general public.

The Jury of Awards making this selection was composed of: Honorable Charles Sawyer, Chairman, Secretary of Commerce; Mr. William J. Grede, President, National Association of Manufacturers; Mr. Dechard A. Hulcy, President, Chamber of Commerce of the U. S.; Mr. Edward H. Stromberg, Director, Publicity and Publications, Northwestern University; Dr. Ray B. Westerfield, Professor of Economics, Hall of Graduate Studies, Yale University. The reader should note that there are approximately 14,000 known trade associations in this country.

The active members of NLGI manufacture about 95 per cent of the lubricating greases produced in this country. Associate members include suppliers of ingredients, equipment, containers, grease marketers, technical and research organizations. Several members from foreign countries are included in the largest membership in our history. Similar superlatives can be applied to the performance of our publication, THE INSTITUTE SPOKESMAN.

The accomplishments of our Technical Committee are too numerous and varied to recount here. Institute members have been and will be kept informed of the results secured by this committee, its panels, and joint committees with other groups.

All of the foregoing attests to the accomplishments and genuine service rendered by those who have gone before. That record likewise serves as a goal to those who come after. The newly elected officers accept that challenge. No doubt, many problems will arise in the coming year. Granted a continuance of the high standard of cooperation among the officers, directors, members and friends, the continued growth of the Institute and strengthening of its position of leadership can be forecast.

NLGI FELLOWSHIP REPORT:

Summary

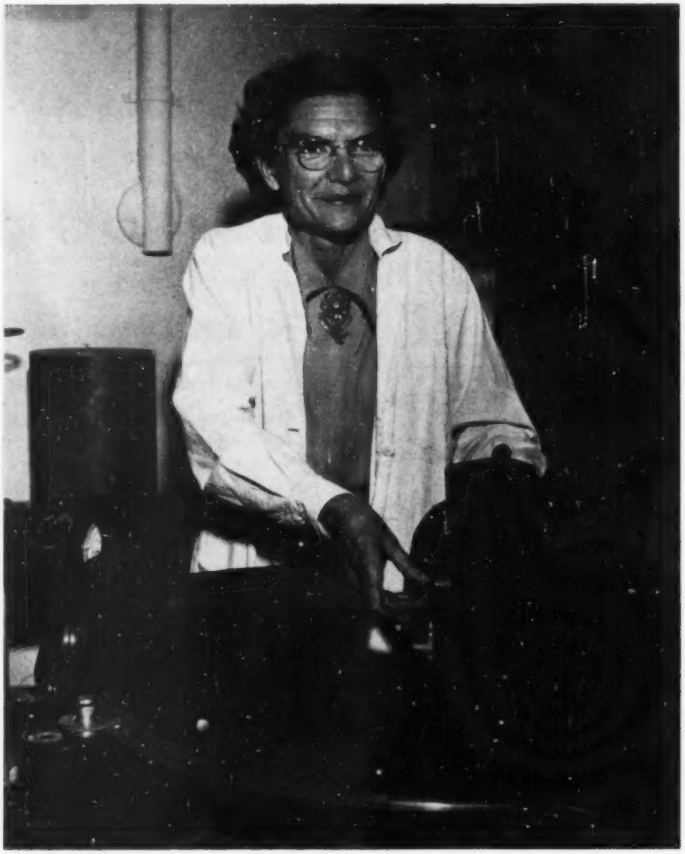
THE principal topic of the studies here reported is the extent to which the soap particles in a grease are mutually independent or, instead, are articulated to form a coherent though plastic soap structure. The answer to this question affects the question of how sizes and shapes of the particles control grease consistency and stability, and what role interparticle bonds play in such properties.

The experimental approach employed is to compare the propensity of the soap particles, which are anisometric, to become oriented by flow with that to be expected from various model structures. Dependence of the intensity of the lines in the x-ray diffraction pattern on the disposition of the sample to the incident beam can be used to measure orientation. The orientation to be expected for a completely articulated structure has been derived. The observed orientation is less than this, but a quantitative description of the difference has yet to be devised. It should be emphasized that the work is in a preliminary stage with many problems still to be resolved before its ultimate value can be assessed.

Introduction

Now that it seems to be well established that the primary structure in a grease is a mesh of crystalline particles it becomes pertinent to explore what can next be done in relating grease properties to this concept. Attention can be focused either on the individual particle or on particle aggregates, and both approaches have already led to interesting results using the technique of electron microscopy. For example, good correlations have been established between the length-width ratio of soap fibers and grease consistency and between fiber breakage or shredding and shearing breakdown of greases (1). Likewise electron micrographs of thin slices of soap gels in cetane have shown the existence of a porous structure seemingly formed of coherent particles (6).

The relative importance of inter-particle contacts in contrast with the size and shape of individual particles has not been assessed. Information on this score would be valuable in trying to devise rational rather than empirical development programs. For if size and shape alone are controlling then rates of nucleation and crystal growth, and rates of development of various crystal faces as a function of experimental conditions, become of primary concern. But if inter-particle cohesion must be considered also then research effort can logically be directed toward selection of additives or oil fractions which will promote such cohesion.



DR. MARJORIE J. VOLD experiments in the laboratory to further her studies under the N L G I Fellowship established two years ago.

However, it is not yet clear exactly how a distinction can be made experimentally between the two factors; in reality, they are certainly not entirely independent. The approach offered here is based on the following model of a grease: The liquid is conceived as being subdivided into droplets, each of which is surrounded by a sheath of soap particles which are ribbon or lath-like in shape and have their flat ribbon faces turned toward the oil. The various sheaths have holes

X-RAY DIFFRACTION STUDIES OF ORIENTED SOAP STRUCTURES IN GREASE-LIKE SYSTEMS

Marjorie J. Vold
Department of Chemistry
University of Southern California

or gaps so that the liquid is actually a continuous phase and the soap particles are mutually adherent so that the soap is also a continuous phase. Such a structure corresponds to a soap-oil gel. Moderate milling reduces the extent of the regions of continuous soap structure to colloidal dimensions and yields a grease. This picture is offered as an alternative to regarding a grease as resulting from capillary imbibition of oil into the interstices formed by dispersing the given soap particles at random through the available volume. The two concepts merge as the rigidity of the sheath diminishes and as the number and size of the gaps increase.

The next problem is that of interpreting measurable properties of a grease in terms of this model structure. One might proceed directly to practical properties such as consistency or stabilities of various sorts on the one hand, or alternatively to direct observations of soap skeletons isolated from the grease. The approach used in this work is intermediate between these extremes. When a grease is subjected to flow, the soap particles become oriented. Some greases become optically birefringent during flow and may remain so even after flow ceases (2, 3, 4). Directional properties of this sort can be detected also through an x-ray diffraction method which has the advantage that the distribution of particle orientations can be obtained rather than only an average. What is presented in this paper is this x-ray method, together with the results of initial efforts to interpret the findings with some soap-oil systems.

The X-Ray Method of Determining Orientation

Only crystallites which have the normal to a set of diffracting planes coplanar with the incident and diffracted beam bisecting the angle between them contribute to the

a. National Lubricating Grease Institute Fellow, 1951-52. *A part of the work presented in this paper was sponsored by the Office of Ordnance Research Contract No. DA-04-495-Ord-303 directed by M. J. Vold.*

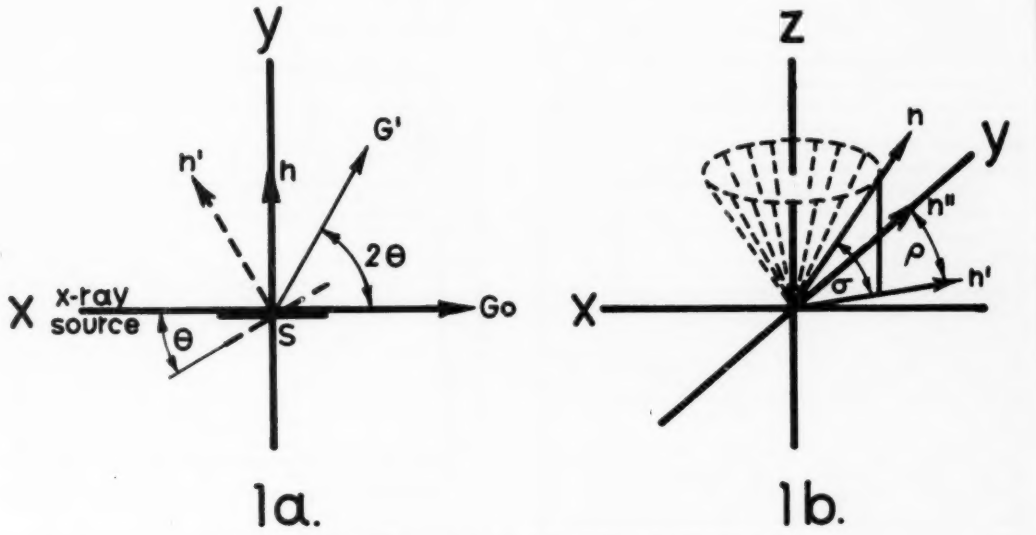


FIGURE 1 DETERMINATION OF CRYSTALLITE ORIENTATION USING THE NORTH AMERICAN PHILLIPS X-RAY SPECTROMETER

In Figure 1a the reflecting planes s have an interplanar spacing corresponding to a Bragg angle θ. Their diffraction records when the Geiger tube is at G′ and comes from crystallites lying initially with normals n to these planes directed along the y axis. As the Geiger tube is moved from G_0 to G′ the sample mounting post also turns to shift n to position n′, satisfying the reflection condition.

In Figure 1b all crystallites for which a given plane normal such as n lies on the cone can be brought into reflecting position by tipping the sample surface relative to the xy plane through the angle σ ($n \rightarrow n'$) and rotating it through the angle ρ ($n' \rightarrow n''$).

FIGURE 2
SAMPLE MOUNTS FOR
ORIENTATION ANALYSIS

Rotation of the inner ring and rotation of the sample holder within the inner ring about its axis provide the necessary mechanisms to set the surface of the sample at any angle to the incident beam.

measured intensity in a diffraction pattern. By so disposing the sample that any direction in it can be brought to this position the spatial distribution of each crystallographic plane can be determined.

In the experiments reported here a North American Phillips X-ray Spectrometer was used throughout. In this instrument the sample surface is made flat. The sample is mounted on a vertical post and the incident beam and Geiger counter lie in a horizontal plane. The post rotates about its axis as the angle between incident beam and counter is changed in such a way that the crystal planes from which diffraction is being measured are always those parallel to the post and coplanar with the incident beam when the Geiger tube is set at $2\theta = 0°$. The geometrical conditions are shown in Figure 1a.

Figure 1b shows the two rotations of the sample needed to bring any direction in it into reflecting position. The most important in this work is the angle σ between a given crystallographic plane and the flat surface of the sample. Normals to these planes form a cone, and the position of a particular plane normal on the cone is measured by the angle ρ.

The absolute intensity of a diffraction line is a composite of many factors including crystal structure, particle size, sample thickness, volume of sample illuminated by the incident beam, etc. Figure 2 shows two sample mounts patterned after those described by L. G. Schulz (5) for use with the given model of spectrometer in such a way that the dependence of the intensity on the disposition of the sample to the beam is a function only of the volume fractions of crystallites in the sample which have a given orientation. The reflection mount in which the diffracted beam emerges from the same surface upon which the incident beam strikes is used for values of σ up to about 50°. The transmission mount must be used for high values of σ in order to avoid artifacts due to variable absorption of x-rays. Finely powdered symmetrical crystals such as sodium chloride give diffraction patterns totally independent of sample orientation.

Packing Characteristics of Calcium Stearate Hydrate VIH

An exploration was made of the preferred orientation existing in solvent-free compacted powdered calcium stearate hydrate in order to relate the various crystallographic planes to the bounding surfaces of the particles. In such a powder, the longest dimension, or surface of largest area of the particles, should lie preferentially perpendicular to the direction of compaction. Such a prediction seems intuitively sound on the basis of comparison with macroscopic analogies such as the mean orientation existing in a barrel of nails or a cashier's drawer full of pennies. It can also be derived on the basis of considering the torque acting to turn particles around the pivot points formed by contact with other particles during the compaction. It was also verified experimentally with graphite which has plate-like particles.

Figure 3 insert gives a diffraction pattern for calcium stearate hydrate VIH. The sequence of peaks at diffraction angles between 2 and 15° arises from diffraction by sets of planes (001) to which the individual soap molecules are nearly perpendicular as judged from the magnitude of the spacing. The intensity of these diffraction peaks is greatest for crystallites in which these planes are parallel to the sample surface and perpendicular to the direction of compaction. The particle is thus plate-shaped or lath-shaped with the 001 planes parallel to its surface of largest area. Accordingly, to determine the degree to which mechanical deformation has

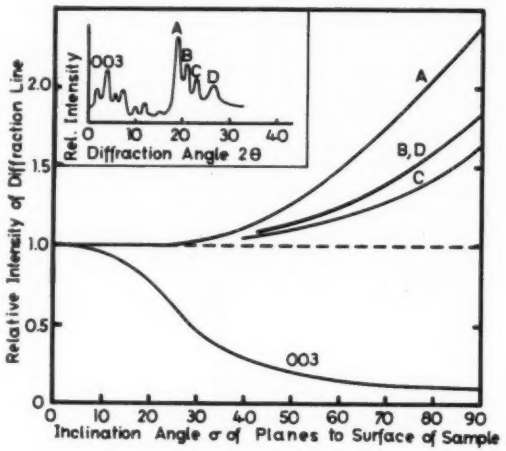


FIGURE 3 PREFERRED ORIENTATION IN SOLVENT-FREE POWDERED CALCIUM STEARATE MONOHYDRATE (VIH FORM)

The dotted line, showing no change in intensity, is that expected for a random distribution of crystallites. Instead, the line from diffraction by the 003 plane is most intense for planes parallel to the surface of the sample and the others are most intense for planes perpendicular to the surface of the sample. The insert identifies the various lines in relation to the over-all diffraction pattern of the soap.

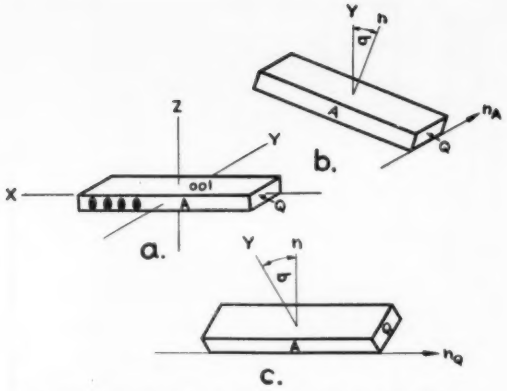


FIGURE 4 SCHEMATIC RELATION OF MOLECULES OF CALCIUM STEARATE HYDRATE AND CRYSTAL PLANES TO THE BOUNDING SURFACES OF THE CRYSTALLITES

In 4a largest face of the crystallite is parallel to the xy plane, i.e., the sample surface. The results shown in Figure 3 identify it as the 001 crystal plane since this is the most common orientation. In both 4b and 4c the largest face is tipped out of the xy plane by the same angle, n_A and n_Q being axes about which rotation has occurred to produce the tip. If orientation 4b is more common than 4c, the result of Figure 3 identify the surface A as the crystal plane of the same designation. The surface Q is not identified, and is probably not a single crystal face but made up of planes B, C, D and perhaps others. The presumed relationship of the molecules to the crystal planes is shown in 4a.

oriented the soap particles in a calcium stearate-oil system, it is the 001 reflections which are most easily employed, and conveniently the third order, which is generally the most intense.

Lines in the pattern labelled in the insert A, B, C, and D are most intense when the contributing crystallites have the corresponding planes perpendicular to the surface of the sample. This orientation is a consequence of the crystal structure of the soap and the orientation of the 001 planes rather than giving additional direct information about the shape of the crystallites.

However, the dependence of intensity upon angle of tilt is more pronounced for the peak labelled A than for the others. This observation can be used to support a hypothesis that the particles are lath-like or ribbon-like rather than disk-like and that planes giving the A spacing form the long edges of the lath or ribbon. The argument is as follows. All the crystallites which have their 001 planes parallel to the surface of the sample will also have their A, B, C and D planes perpendicular thereto, but some of those whose 001 planes are tipped away from the sample surface may also have *one* of these planes perpendicular to the surface of the sample. If the particles are discs, which of them is so oriented will be a matter of chance, but if the particle is a lath or ribbon, it seems more likely that the rotation required to tip it will occur about the short axis rather than the long axis of the particle, leaving the planes whose normals parallel the short axis, i.e., those parallel to the ribbon edge, still perpendicular to the sample surface.

This consideration, and the associated disposition of the soap molecules in respect to the anisometric crystallite, is illustrated in Figure 4. It is noteworthy that the suggested schematic arrangement is contrary to that found by Bondi and collaborators (1) for sodium soaps. Bondi has correlated his finding with the tendency of sodium soap fibers to shred parallel to their length. The different arrangement for calcium soap molecules may be similarly correlated with the failure of calcium soap particles to undergo similar shredding and thus ultimately relate to differences in shear stability of calcium base greases as compared with sodium base greases.

Exploration of Orientation Effects In Commercial Greases

It was thought desirable to ascertain whether or not nonrandom orientation of soap particles occurs in commercial greases and whether different ones display any appreciable differences in this respect. Figure 5 shows the results obtained on a set of samples previously used for x-ray and thermal studies in this laboratory (7). The samples were prepared by piling a blob of grease lightly in the sample cup of the reflection mount, and packing it down with a spatula, stroking to remove air bubbles. Finally the cup was inverted on a glass plate and rubbed vigorously back and forth.

The six grease samples do display marked differences. The soap particles in one sodium grease and one calcium grease

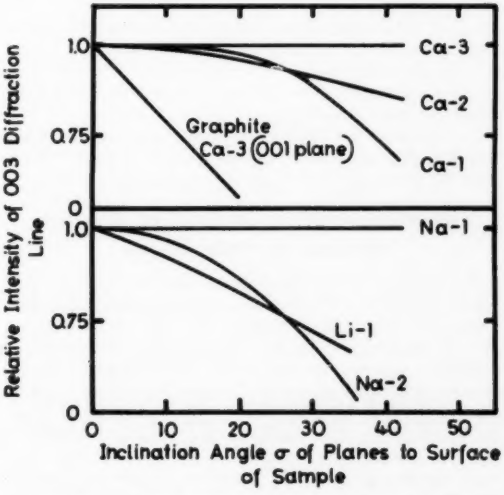


FIGURE 5 PREFERRED ORIENTATION IN SIX COMMERCIAL GREASES

Na-1 and Ca-3 show no preferred orientation. The others show varying degrees of preference to have the 001 planes of the soap particles parallel to the sample surface.

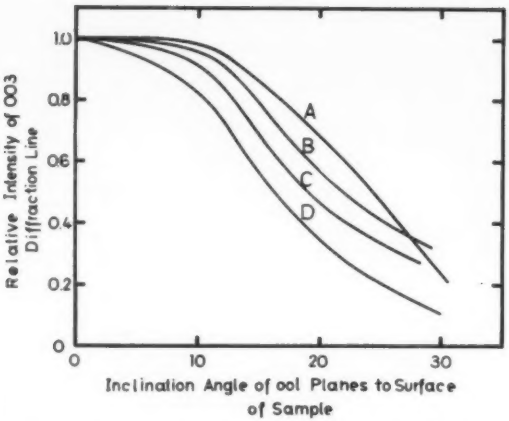


FIGURE 6 ORIENTATION OF SOAP CRYSTALLITES AS A FUNCTION OF SAMPLE TREATMENT. PASTES OF 45% CALCIUM STEARATE HYDRATE IN CETANE

A. Sample filled into cup with a spatula. B. Extruded rapidly as a ribbon 1 mm. thick and 16 mm. wide under 19 psi. C. Extruded slowly under 14 psi as rods 1 mm. in diameter, piled like logs in the sample cup, and then pressed together to form a flat surface. D. Extruded as a cylinder 6 mm. in diameter and then deformed by vertical pressure to a cylinder 16 mm. in diameter to just fill the sample cup.

were not oriented at all by this treatment even though the graphite particles in the calcium grease were highly oriented, with the plates parallel to the sample surface. Two samples of calcium greases, one sodium grease and one lithium grease, displayed varying tendencies to set the 001 planes of the soap crystallites parallel to the sample surface. To what structural factors these differences are due is not yet at all clear but is the principal topic of immediate research.

Mechanical Pastes of Calcium Stearate Hydrate in Oily Media

The balance of the experimental data contained in this paper were obtained on pastes or room temperature dispersions of calcium stearate hydrate in cetane, rather than on gels or greases (i.e., thermal dispersions). The principal difference between the two kinds of dispersion can be thought of in terms of the larger size of particles or particle aggregates in the paste, or alternatively in the smaller number of inter-particle contacts, so that the results provide a basis for evaluating the behavior to be expected from relatively independent particles. Moreover, the absolute intensities of the important 001 lines in the patterns of such systems are relatively more intense than in thermal dispersions so that experimental results are more trustworthy. The following generalities were established:

1. The orientation induced in a given sample whether random or not is time stable over periods of several days. This means that a state of partial orientation is not to be

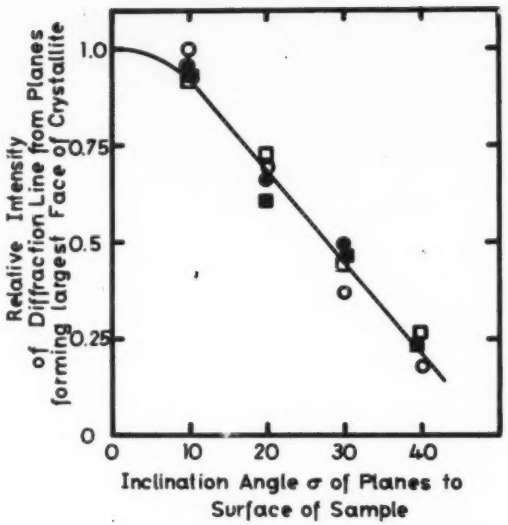


FIGURE 7 UNIFORMITY OF PREFERRED ORIENTATION OF SAMPLES SUBJECTED TO THE SAME MECHANICAL TREATMENT

● 4% graphite in vaseline
□ 50% graphite in vaseline
■ 25% calcium stearate hydrate in cetane
O 25% calcium stearate hydrate in nujol

considered as a steady state in which forces resulting from flow under shearing stress are balanced against the disorienting effect of Brownian movement, as in streaming double refraction.

2. The extent of the orientation is quite sensitive to the way in which the sample has been treated, although reproducible results can be obtained without great difficulty. The situation seems to be that the orientation depends on the state of strain or deformation to which the sample is subjected, and this is not easy to characterize nicely even though it can be reproduced in the laboratory. The extent to which the 001 planes of the crystallites set themselves parallel to the surface of the preparation for various mechanical treatments is shown in Figure 6 for a 45% soap paste. The curves are all of the same character, with the 001 surfaces of the particles preferentially parallel to the direction in which flow occurs during the deformation.

3. For the same mechanical treatment, pastes of the same soap powder in oily media varying in viscosity from cetane to vaseline display nearly the same degree of orientation. A few dispersions were made of an uncharacterized* powdered graphite for which the same generalization is valid. For the graphite, the degree of orientation was unaffected by changing the particle concentration between two and fifty per cent

The dry powder readily passed a 250 mesh sieve, and was seen under the microscope to consist principally of flakes 25-50 μ in diameter but with many finer particles.

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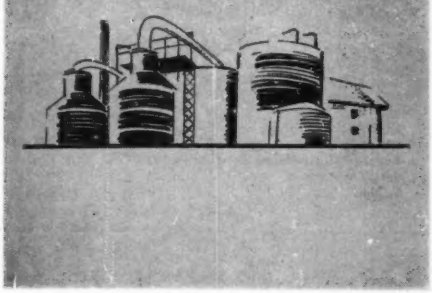
Acid Value	195	-	198
% F.F.A. as Oleic Acid	98	-	99.5
Iodine Value (WIJS)	88	-	92



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in vaseline. This also applies to soap pastes but the concentration was not varied so widely. The two different powders, soap and graphite, were found to have nearly the same tendency to become oriented as is seen in Figure 7. This result came as a surprise since one would expect the effect to depend on particle size and shape which would be expected to be very different in the two cases, but so far measurements have not been made to test this point.

The Formulation of a Theoretical Approach

These orienting experiments led to the conclusion that the primary variable to be considered in formulating a theoretical approach is the mechanical treatment to which the sample is subjected in order to induce orientation. Differences in viscosity of the medium, concentration of the dispersion, and possibly even particle size, produced less variation experimentally than this factor.

In formulating the theoretical approach it is desired to involve the degree of articulation of any inter-particle structure that may exist. It should be pointed out that such structures are likely to be a consequence of inter-particle forces existing at room temperature rather than being entirely residues of a structure formed at higher temperatures so that some structure is to be expected even in these systems of relatively independent particles.

An approximate equation has been derived giving the relative numbers of soap crystallites in which the faces of largest area (001 planes) are inclined to the surface of the sample when it is prepared in the form of a right circular cylinder of height h_1 and then uniformly compressed to a height h_2 with lateral outward flow occurring along the radii of the cylinder. It is assumed that each volume element undergoes the same change in shape as the bulk cylindrical sample. The assumption is made that the soap particles have an articulated structure so that the total circumference of a pore remains constant during the process.

Figure 8 gives a schematic illustration of the concept. Figure 8a shows a cross-section of a spherical oil region surrounded by flat soap particles each tangent to the sphere. This represents the average orientation before deformation. The number of soap particles inclined at any angle to a horizontal reference plane is the same as the number inclined at any other angle. But if the region is deformed without slipping of the particles, as in Figure 8b, the number of soap particles inclined at small angles increases and the number inclined at large angles decreases. However, the same deformation produces a much lesser degree of orientation if the soap particles can slip past each other penetrating into the oil as shown in Figure 8c. Experimental results are compared with the limiting case shown in Figure 8b and the differences interpreted as a property of the system related to the strength of inter-particle contacts.

A cross-section of the deformed pore is taken as an ellipse. An element of arc ds along the ellipse is proportional to the number of soap particles having the same orientation as the tangent to the ellipse at that point. The outline of the derivation is as follows:

The slope of the tangent to an ellipse, expressed in polar coordinates is

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Free Inorganic Acid	0.32%
Free Neutral Fat	None
Saponification Value	170
Iodine Value	25
Apparent Solidification Point (titre)	42° C.
Softening Point	45° C.
Sulphur	0.1%

A.O.C.S. Methods

$$m = -\frac{1}{f^3} \operatorname{ctn} \theta \qquad (1)$$

where $f = a/b$ is the ratio of major to minor axis. The length of the element of arc may also be readily expressed as a function of the polar angle θ. The desired expression is the rate of change of the element of

$$\frac{1}{a^2}\frac{ds^2}{d\theta} = \frac{1+f^4\tan^2\theta}{(1+f^2\tan^2\theta)^3} \qquad (2)$$

arc with the angle σ between the tangent soap particle and a horizontal line (in the plane of the sample surface). That is, it is necessary to calculate $ds/d\sigma$ where $\sigma = \text{arc tan}\left(-\frac{1}{f^2}\operatorname{ctn}\sigma\right)$. Making the desired change of variable, and setting a arbitrarily equal to unity, one obtains

$$\frac{ds}{d} = \frac{ds}{d\theta} \div \frac{d}{d\theta} = \left(\frac{1+\tan^2\sigma}{1+f^2\tan^2\sigma}\right)^{3/2} \qquad (3)$$

The relation of the amount of deformation of the bulk cylinder to the ratio f of major to minor axis of the deformed oil pores on the assumption of a constant perimeter is a little complicated since the perimeter of an ellipse is expressed as an infinite series. However, the expression

$$2\frac{h^2}{h_1^2} = (1+f)\left(1+\frac{1}{4}\left(\frac{f-1}{f+1}\right)^2+\frac{1}{64}\left(\frac{f-1}{f+1}\right)^4+\cdots\right) \qquad (4)$$

can be solved readily by successive approximations.

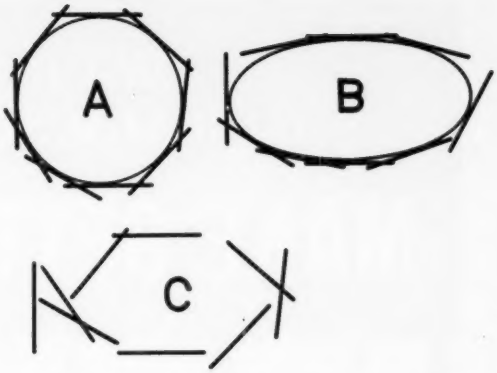

FIGURE 8 SCHEMATIC PICTURE OF THE EFFECT OF DEFORMATION ON THE SOAP STRUCTURE OF A GREASE

A. Cross-section of a pore enclosed by soap particles which have all orientations. B. The same pore after compression for the case of a completely articulated soap structure. C. The same pore after compression for the case of a completely unarticulated structure. In C the random arrangement of the soap particles is preserved. In B the particles are almost all more nearly parallel to the horizontal axis than before deformation.

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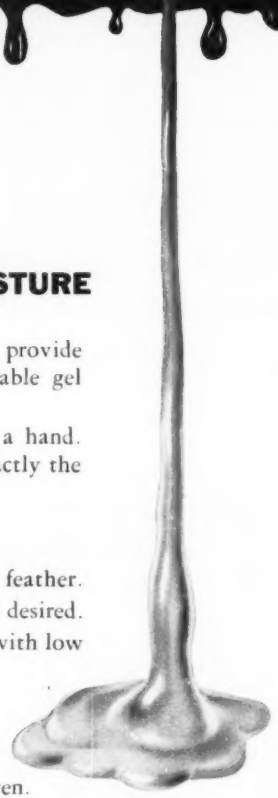

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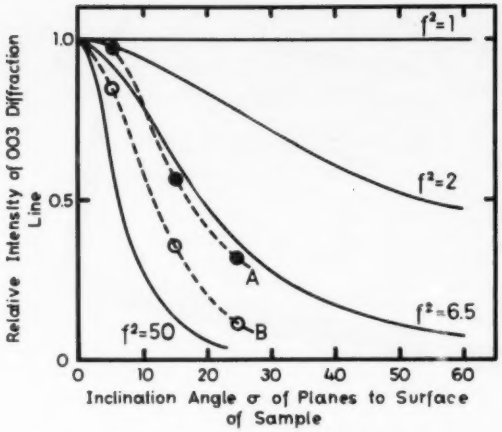

FIGURE 9 PREFERRED ORIENTATION OF SOAP PARTICLES IN DEFORMED GREASE CYLINDERS

Solid curves are calculated from Equation 3 for various extents of deformation. Curves A and B are for a 45% paste of calcium stearate hydrate in cetane. They correspond to apparent f^2 values of 6.8 and 9.4. The applied deformations were 12.0 and 110, indicating imperfect articulation of the structure (or non-uniform deformation or both).

Figure 9 is a plot of equation 3 for various values of f upon which two experimental curves are super-posed. The curves are for deformed cylinders of pastes of calcium stearate hydrate in cetane. They seem to conform in general shape to the set of theoretical curves rather well. A paste with a completely articulated soap structure conforming exactly to equation 3 would yield curve A very closely if the experimental f^2 were 6.8 whereas that applied was 12.0. The difference might be taken as a measure of the degree of articulation of the structure on an empirical basis. However, the value of f^2 required to make curve B, on the same paste conform to equation 3 is only 9.4 whereas in this case the applied deformation corresponded to an f^2 of 110. It is possible in this case, however, in which a tall narrow cylinder was flattened out manually, that the deformation itself was not uniform and further experiment is needed before any sound conclusions can be drawn.

This work is being continued on the supposition that the variation of the preferred orientation in a deformed grease block from the prediction of equation 3 (or a more adequate successor) can be used to measure the degree of articulation of its inter-particle structure, which can then in turn be studied as a function of particle size, shape, composition, thermal history and other variables.

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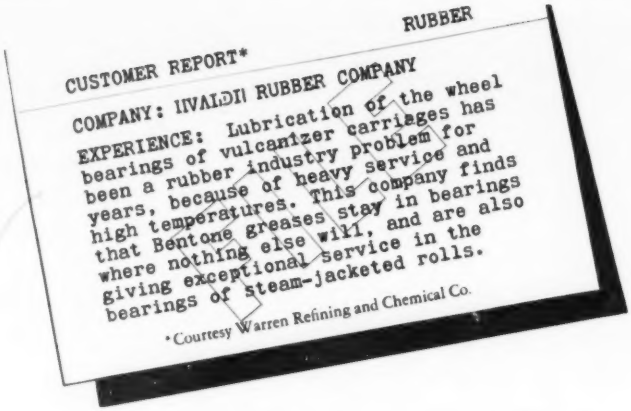
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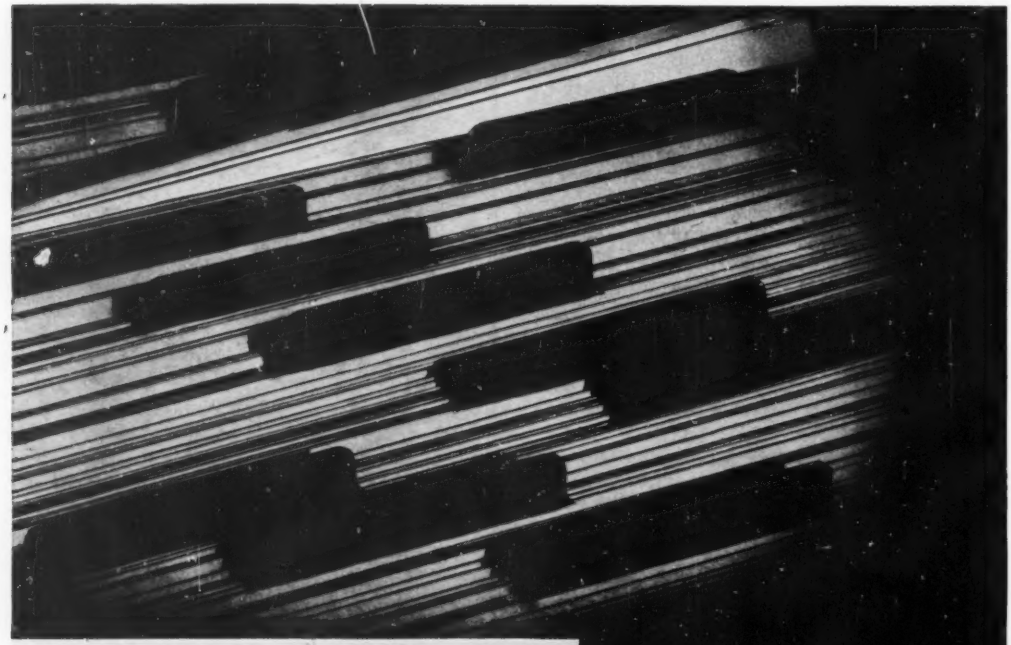

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Patents and Developments

Stainless Emulsifiable Grease

A grease having, as major ingredients, an alkaline base oil (containing alkali metal petroleum sulfonates and a lubricating oil of 75-500 SSU at 100° F.), a lubricating solid such as talc and mica, minor amounts of tall oil, a polyhydroxy alcohol, an oil soluble corrosion inhibitor and a fatty acid, is described in Standard Oil Development Company's patent 2,599,353. It is recommended in pipe bending and wire drawing operations.

The alkaline base oil may be prepared by exhaustively sulfonating with concentrated sulfuric acid a solvent extract of a lubricating oil fraction obtained from a naphthenic base crude, such as a phenol extract, the oil being neutralized with caustic alkali, and then finished by blowing with air to remove moisture. The finished base oil contains 10-15% by weight of alkali metal petroleum sulfonates, in addition to some excess caustic alkali.

The following table, Table 1, shows the range of components which may be employed in the composition:

Table I

	WEIGHT		PER CENT
Alkaline Base Oil	25	—	75
Petroleum Sulfonate	2.5	—	11.5
Oil	22.5	—	63.5
Tall Oil	0.5	—	2.0
Polyhydroxy Alcohol	0.5	—	2.0
Cyclohexylamine	0.3	—	1.0
Fatty Acid	0.05	—	0.2
Talc or Mica Ratio to Base Oil	1:2	—	2:1

The tall oil is used to impart adhesive powers, while the polyhydroxy alcohol imparts water emulsibility. Cyclohexylamine is the preferred corrosion inhibitor, and the fatty acid is employed to improve the lubricating properties of the mixture and to react with excess alkali.

A grease, used successfully in a large petroleum refinery in bending pipe of large diameters, has the following composition. (Shown in Table II):

Table II

COMPOUND	WEIGHT PER CENT
Alkaline Base Oil	60.23
Tall Oil	0.62
Diethylene Glycol	0.62
Cyclohexylamine	0.44
Stearic Acid	0.09
Talc	38.00

Alumina Gel Grease

Inorganic gel greases, such as those employing alumina gel, have been found satisfactory for lubrication at high temperature conditions. In U. S. patent 2,599,683, issued to Shell Development Company, it is pointed out that alumina gelling greases, employed in lubricating steel rolling mill bearings, tend to separate to form lubricating oil and alumina gel phases, apparently due to their sensitivity to water. In the case of silica gel, stabilization has been successful by use of high molecular weight soaps or amines.

Since alumina is an amphoteric oxide, the patent recommends the use as a stabilizer, of lipophilic high molecular weight acid having at least 10 carbon atoms and especially belonging to the classes of phosphinic acids, phosphonic acids, fatty acids, aliphatic dicarboxylic acids, amino fatty acids, sulfonic acids, or naphthenic acids and their chlorinated, sulfurized and phosphorized derivatives. The greases are waterproofed by the presence of about 5-15% of the weight of the gel of the acids specified.

Examples of such acids are n-octadecane-1-phosphonic acid, petroleum hydrocarbon sulfonic acid, 3, 5-diisobutyl benzene phosphinic acid, etc.

Grease Containing Soap of Phosphated Hydroxy Fatty Acid

One oil thickener suitable for preparing lubricating greases, proposed in U. S. patent 2,600,058 issued to The Texas Company, is the soap of a phosphated hydroxy fatty acid or glyceride. An example of a suitable material for making such a soap is phosphated castor oil having the phosphate group linked to the glyceride of ricinoleic acid by replacing the hydroxy group in the 12-position. A commercial phosphated castor oil gives the following tests:

Neutralization number	135 to 160
Saponification number	290 to 310
Iodine number	75 to 80
Phosphorus (total), per cent	3.5 to 4.6

Such a material contains about 45-50% by weight of phosphated castor oil and 50-55% of castor oil.

Typical greases made with various metal soaps of this material have the properties outlined in Table III.

Low concentrations of these soaps in lubricating oil are claimed to provide a liquid lubricant of added body, greater load carrying capacity, and better corrosion and rust resistance, as compared with the base oil. Many of the sodium, lithium and sodium-calcium greases have unusually high dropping points, above 500° F., and a lithium grease of this type, when compared with "a conventional lithium base low temperature grease prepared from hydrogenated castor oil and now on the market" has the advantage of higher dropping point, higher mean Hertz load, no stain in copper corrosion tests, and much better salt spray corrosion results.

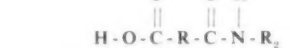
Greases Containing Soaps of Amic Acids

One patent recently issued to Swan-Finch Oil Corporation (U. S. 2,604,449), proposes to use, as a thickener, salts or

Table III (Additional tests also are given.)

Metal	Soap, Percent Calculated	Drop. Pt., °F.	ASTM Penetration, Unworked	77° F. Worked	Appearance
sodium	13.5	485	144	293	transparent light yellow, stiff, buttery.
lithium	12.6	500+	138	269	clear amber, light feather.
magnesium	20	340	275	344	transparent amber, stringy.
zinc	20	233	201	274	opaque ivory, soft, buttery.
aluminum	23.8	224	191	249	amber, transparent gel.
sodium-calcium	10	407	128	273	transparent pale yellow, hard, buttery.
sodium-lead	15	268	157	286	tan, stiff, buttery.

soaps of amic acid having the formula



where R is selected from the group consisting of methylene groups having a carbon chain length of 1-8 carbon atoms and the group

while R_1 is an aliphatic radical of a carbon chain length of 4-18 carbon atoms, and R_2 is selected from the group consisting of hydrogen and an aliphatic radical of a carbon chain length of 4-18 carbon atoms.

These salts are mixed with lubricating oil in the concentration of 6-17% of the grease to form a smooth, semi-solid mass at room temperature. Among the acids suitable for such use are N-mono-n-butyl-sebacamic acid, N-dipalmityl-sebacamic acid, N-mono-n-octyl-adipamic acid, N-mono-myristyl-azelaamic acid, N-mono-decyl-malonamic ester, N-mono-butyl-itaconamic acid, etc. The alkali metal salts or polyvalent metal salts are employed.

High Soap Synthetic Ester Greases

One way to incorporate amounts of soaps hitherto believed impossible in synthetic ester carriers, is to employ, as

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the thickener, a mixture of a fatty soap and an acyl p-amino phenol. According to U. S. Patent 2,604,450 issued to Standard Oil Development Company, greases of this type show good light stability, good structural stability, and good low temperature properties.

Ordinarily, it is necessary to use 0.5-5% of a stabilizer in order to incorporate 12-21% of ordinary soap thickeners in synthetic ester carriers, whereas with the use of soaps and N-acyl p-amino phenols, good greases can be prepared by using 1-6% of an alkali metal or alkaline earth metal soap, incorporated into the ester carrier at 350-480° F. with stirring. Then, in a separate kettle, 1-12% by weight of the desired N-acyl p-amino phenol is admixed with a mineral lubricating oil and heated with stirring to about 250° F. When the ester solution of fatty acid soap has cooled to 250° F., the oil-amino phenol mixture is added and the whole mass is allowed to cool to room temperature, resulting in a clear solid grease structure.

Among the synthetic esters suitable as the carrier media are the adipic, suberic, azelaic and sebacic acid esters. Oxo alcohol esters of dihydroxy acids also are satisfactory. The amino phenols may be N-palmitoyl p-amino phenol, N-stearoyl p-amino phenol, N-arachidoyl p-amino phenol, and similar compounds.

One satisfactory formula contains:

6.0% lithium stearate
2.0% stearoyl p-amino phenol
23.0% refined naphthenic distillate of 35 SUS at 210° F. and pour point of —45° F.
69.0% di-2-ethyl hexyl sebacate

Such a grease is reported to have the following properties:

Dropping point	360° F.
Water solubility (30 min. at 210° F.)	Nil
Penetration: (mm./10 at 77° F.) unworked	280
Worked—	
60 strokes ASTM worker	310
80,000 strokes ASTM worker	340

News Items

The B & O is studying the possibility of using molybdenum disulfide dust as a lubricant on the moving surfaces of Diesel machinery and car axles. The lubricant is not affected by very low or very high temperatures (Balt. Eve. Sun 8/29/52 p. 36).

U. S. Pat. 2,599,456 (Ivie) Ball and roller type bearing greasing apparatus.

U. S. Pat. 2,604,958 (Leufvenius) Hydraulic grease coupling.

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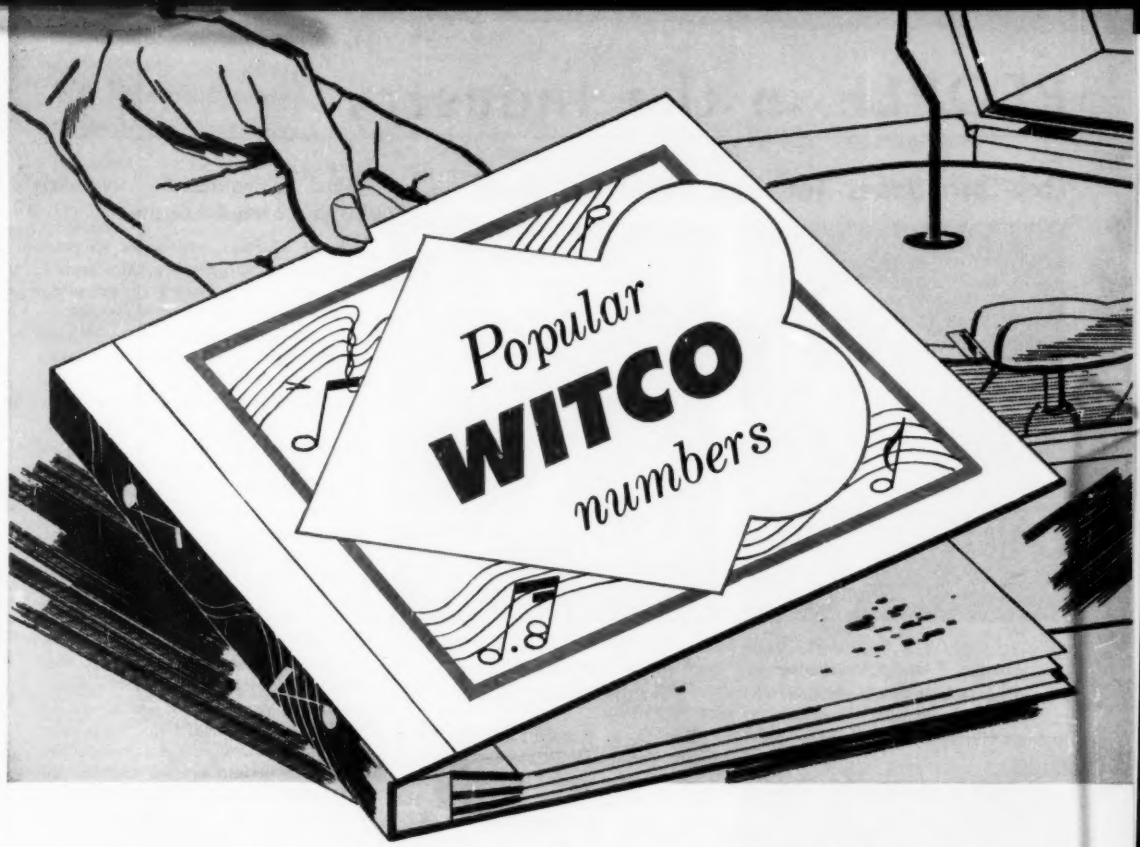

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These three lead soap requirements are readily met by Witco's 30% and 33% Lead Naphthenates and 25% Lead Oleate. Witco Lead Soaps provide desirable extreme pressure characteristics. Their clarity is outstanding.

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PEOPLE in the Industry

Chek-Chart Names Two New Department Heads

LEONARD W. OKON
Manager, Editorial-Engineering
The Chek-Chart Corporation

ROBERT J. MAHAFFAY
Director of Engineering
The Chek-Chart Corporation

Ray Shaw, presdient of The Chek-Chart Corporation, Chicago, publishers of lubrication guides and other automotive service data, announces two major staff appointments. Robert J. Mahaffay, formerly manager of the firm's editorial-engineering department, has been named director of engineering. Mr. Mahaffay's sound engineering background, B.S., mechanical engineering, University of Illinois, has been augmented by extensive experience in the Navy and in all phases of engineering and development at Chek-Chart. He takes over the post recently vacated by Gordon Glassford who resigned to return to Canada.

Leonard W. Okon, another University of Illinois graduate, B.S., Ch. E., has been appointed manager of editorial-engineering to replace Mr. Mahaffay. Mr. Okon's considerable experience in laboratory testing of metals and petroleum products is balanced by actual field experience with the Deep Rock Oil Corporation. There, before joining Chek-Chart more than a year ago, Mr. Okon was superintendent of lubrication, central area.

Both appointments were effective immediately and both men have been directing their respective departments for several weeks.

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Gardner Promoted To Research Associate

R. H. Gardner, veteran of 33 years employment with Sinclair Oil Corporation, has been promoted to the newly created position of research associate.

Mr. Gardner started his career with Sinclair upon being honorably discharged from the Army after World War I. His tion, has been promoted to the newly Chicago refinery, were he remained for approximately 12 years. He was transferred from there to Sinclair's Coffeyville, Kansas, refinery, where he became head of the technical department. Five years later he returned to the research and development department, then located at Sinclair's East Chicago refinery, where he was a member of the lubricants division and later was promoted to the director of lubricants research division for Sinclair Research. He has been connected with this division for approximately 16 years, during which time he has been instrumental in many new developments and processes which Sinclair has put into operation. Primarily, Mr. Gardner's work at Sinclair Research Laboratories, Inc., has dealt with lubricating oils and greases in the fields of research, development and application. Mr. Gardner's long experience in the oil industry has also included the development of many new and better wax products for Sinclair.

Mr. Gardner, widely known to refinery and research people, holds memberships in several organizations, among which are the Society of Automotive Engineers, and the American Society of Lubricating Engineers.

The new position Mr. Gardner has assumed is so designed to enable him to utilize all his time on research projects rather than dividing his time between research activities and administrative details.

Announcement

Effective in October, Dan D. Downes, sales manager of the Brown - Allen Chemical Company, formerly Brown Oil & Chemical Corporation, has severed his connection with the company.

He will announce his future plans later.

J. D. Leonard Becomes Aries Senior Associate

Jackson D. Leonard, a chemical engineer from Metuchen, N. J., has joined R. S. Aries & Associates, Consulting Engineers & Economists, 400 Madison Avenue, New York 17, N. Y., as a senior associate, it has been announced by Dr. Robert S. Aries.

Mr. Leonard has had 15 years of widely varied chemical plant experience in the fields of supervision, engineering, construction, maintenance and development. His early industrial years were spent with General Chemical Company and later at a number of plant locations with E. I. duPont de Nemours & Co., and with Merck & Co.

Mr. Leonard has specialized in cost reduction programs, and has developed one of the most modern approaches to reduction of maintenance costs yet conceived for the chemical process industries. Mr. Leonard's broad background in the field of practical chemical engineering application will enable R. S. Aries & Associates to expand further their varied and integrated services to the process industries.

Mr. Leonard is an active member of the American Institute of Chemical Engineers and is a registered professional engineer.

E. R. Clouse Promoted At Sinclair Research

E. J. Martin, vice-president and general manager of Sinclair Research Laboratories, Inc., announces that E. R. Clouse has been promoted to the newly created position of superintendent, buildings and grounds.

In assuming his new post, Mr. Clouse vacates his former position of foreman of the Sinclair Research Pilot Plant, a post he has held for the past nine years. Before his pilot plant duties, Mr. Clouse worked in the development department on gasoline and lube treating in Sinclair's Houston and East Chicago refineries. He started with Sinclair in 1929, after graduation from Indiana State Teachers College with a degree in Chemistry and Mathematics.

Otto F. Slonek Joins Witco Chemical Staff

Witco Chemical Company announces that Mr. Otto F. Slonek, formerly manager of Industrial Chemical Services, Inc., Houston, Texas, has been added to the staff in a technical sales service capacity on chemicals.

Mr. Slonek is a graduate of the University of Illinois and has done graduate work at Oregon State College.

Foote Chooses Manager Of Sunbright Division

Oscar M. Wicken recently joined Foote Mineral Company as manager of the Sunbright, Virginia, division. This new division covers the production of lithium chemicals and the quarrying of limestone.

Mr. Wicken, a graduate of the University of Washington, first worked for Howe Sound Mining Company before obtaining his master's degree in mineral beneficiation from the University of Idaho in 1941. From 1941 until joining

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2,568,569
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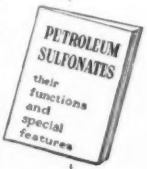

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Foote, Mr. Wicken was with Northwest Magnesite Company in various engineering and supervisory capacities, most recently as Manager of the Magnesia recovery plant at Cape May, New Jersey.

In addition to membership in A. I. M. E., Mr. Wicken is also a member of A. C. S., Sigma Gamma Epsilon and Sigma Xi.

Continental Can Appoinis 2 Dis:rict Sales Managers

Continental Can Company has announced the appointments of two new district sales managers.

John S. Devlin has been appointed district sales manager of Continental's Houston district and Bruce R. Petersen has been appointed district sales manager of the Milwaukee district.

Mr. Devlin, who has been with the company since 1948, was formerly control officer in Continental's head office in New York. Before serving as control officer, he was assistant to the executive vice-president of the metal division and earlier served as product sales manager of steel containers. In his new capacity, he will direct the company's sales activities in Texas and New Mexico.

Mr. Petersen, who joined the company in 1947, was formerly Boston district sales manager of Continental's eastern metal division. Before serving as district sales manager in Boston, he was a staff assistant in the eastern division offices and, earlier, sales representative in Philadelphia and New York.

Foote Adds C. P. Miller To Research Depar:men:

Foote Mineral Company announces the addition of Charles P. Miller, Junior Mineralogist to its research and development department at Berwyn, Pennsylvania. Mr. Miller is a graduate of Lehigh University with a B. A. degree in geology and a B. S. degree in mining engineering. He was formerly with New Jersey Zinc Company.

WM. C. BRYANT replaces W. A. Magie, 2nd, as N L G I Technical Committee representative for Magie Bros. Incorporated.

W. D. THOMAS, JR., replaces E. A. Wieland as N L G I company representative for American Cyanamid Company.

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The Physical Chemistry of Surface Films

by W. D. HARKINS
Andrew MacLeish Distinguished Service Professor Emeritus, University of Chicago

This important book covers all the fundamental pioneer work of the late W. D. Harkins on the mechanism of liquid/liquid films and interfaces, surface tension, emulsification, energetics of surfaces, films on liquid and solid subphases, and properties of long-chain electrolytes. Also included is an introductory study of the electric layer. Though some of the material has appeared in earlier publications, this volume serves as an invaluable guide to the many advances in emulsion technology — including emulsion polymerization — on which the author was working at the time of his death. All lubrication chemists, physicists — indeed, any scientist whose work involves an understanding of films, foams, or any type of heterogeneous system — will find this basic treatise of immense value.

1952, 425 pages, $10.00

Performance of Lubricating Oils

by H. H. ZUIDEMA
Shell Oil Company Research Laboratory, Wood River, Illinois

Amply supplied with helpful charts, tables and illustrations, this new book summarizes and evaluates the wealth of data on the performance characteristics of lubricating oils under various conditions. Here, you'll find discussions not only of general lubrication requirements, but **entire chapters** devoted to the lubrication process, flow characteristics, sludge and lacquer deposition, emulsification and foaming, and other important topics. In addition, a special chapter points out the effects of each step in the manufacturing process upon the performance characteristics of the final product.

American Chemical Society Monograph,
1952, 250 pages, $5.00

USE THIS HANDY COUPON TO ORDER

Physical Chemistry of Lubricating Oils

by A. BONDI
Shell Development Company, Emeryville, California

This volume offers you the latest theories on lubricating oils, and the physical and chemical principles underlying their action. Many inaccessible or widely scattered data and simple methods for the estimation of unknown properties from few given data will prove most valuable to engineers, physical chemists and all technical men in the lubrication field. Such properties as viscosity, pour point, oiliness, flow characteristics, foaming, etc. are discussed in great detail and attention is given to additives of all types. Synthetic lubricants and reaction kinetics are also fully treated.

1951, 450 pages, $10.00

Motor Oils and Engine Lubrication

by CARL W. GEORGI
Technical Director, Research Laboratories, Quaker State Oil Refining Corp.

The practical problems of engine usage, maintenance and lubrication, as well as causes and remedies affecting operating troubles, are described in this comprehensive book. It is the first of its kind to assemble for ready reference detailed information on the properties and service behavior of motor oils. Particular emphasis is laid upon viscosity index and its importance in all phases of motor lubrication. Detailed specifications covering various types of engine tests are included, together with properties of lubricants and all types of performance ratings.

1950, 515 pages, $9.50

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Industry NEWS

Emery Announces Improved Vegetable Fatty Acids

The addition of new products and the improvement of others now completes a wide selection of Emery vegetable type fatty acids to meet any vegetable requirements, Emery Industries Inc., has announced.

Of particular interest to alkyd resins manufacturers is the improved quality of Emery distilled cottonseed type fatty acid and Emery distilled soya type fatty acid with respect to lighter colors and better overall uniformity.

Also of considerable interest are two new tailor-made soya type fatty acids, both of which offer color and iodine value advantages.

These fatty acids offer a complete selection of fatty acids for alkyd resins. For other uses, Emery provides a wide selection of highest-quality vegetable type fatty acids.

For complete specifications and compositions of these Emery vegetable type acids, write to:

Emery Industries, Inc.
Dept. 5 — Carew Tower
Cincinnati 2, Ohio

Brown Chemicals Formed By Edward G. Brown

Edward G. Brown announces that effective October 1, 1952, he has formed the Brown Chemicals, with headquarters at 15 Moore Street, New York 4, New York.

The company will engage in the manufacturing, chemical processiing, importing and distributing of vegetable oils and vegetable oils specialties.

W. D. Hodges, Colonial Building, 100 Boylston Street, Boston, Massachusetts, has been appointed New England representative.

Fred G. Weigand has become associated with the company as technical sales service representative with headquarters at 15 Moore Street, New York 4, New York.

Continental Can Wins Award for Annual Report

In the final ratings of the independent board of judges in the "Financial World" Survey of Annual reports, Continental Can Company, Inc., was judged as having the best annual report of the Food Container industry, for the third consecutive year. The bronze "Oscar of Industry" trophy was presented to Hans A. Eggerss, president of the company, at the Annual Awards Banquet in the Grand Ballroom of the Hotel Statler, New York, on October 28, 1952.

A total of 500 annual reports was considered this year in the international competition ,the twelfth in the series of surveys. These were judged in 100 industrial classifications for the "Best of Industry" awards. In the food container category, Owens-Illinois Glass Company was runner-up for top honors, while American Can Company placed third.

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Midwest Research Sponsors Two-Day Symposium To Be Held in Kansas City

The place of automatic computing equipment in industry will be the subject of a two-day symposium to be held in Kansas City, January 8 and 9. This meeting is sponsored by Midwest Research Institute in cooperation with local sections of the American Society of Mechanical Engineers, the American Society of Civil Engineers, American Institute of Chemical Engineers, Instrument Society of America, American Institute of Electrical Engineers, Institute of Radio Engineers, and the Society of Automotive Engineers.

Representatives from industry, government, and educational institutions throughout the country will attend this session to hear papers and discussions on such subjects as operations of digital computers, analog computers, organization of a computations center, and the application of computers to problems in the various branches of engineering. Principals from companies which manufacture computing equipment will explain the systems of their respective machines, with special attention to applications in engineering.

Use of computers in the automotive industry, chemical industry, aircraft production, process control, and structural design are among the specific subjects which will be explored at this meeting. A portion of the program will be devoted to a round-table discussion of the engineering uses of automatic computation, allowing all participants to exchange information and ask pertinent questions of the guest speakers.

According to Martin Goland, associate director for engineering at Midwest Research Institute, "this meeting offers a unique opportunity for engineers in research and industry to get first-hand knowledge of how automatic computation can be used to advantage in solution of engineering problems."

A complete digest of the program may be obtained by writing Mr. Goland in care of Midwest Research Institute, 4049 Pennsylvania, Kansas City, Missouri. Advance registrations are requested and may be placed with Mr. Goland.

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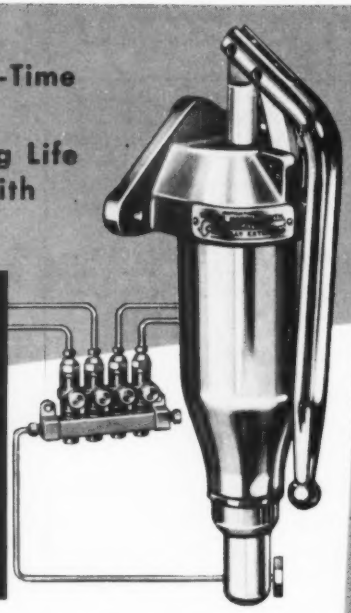

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GREASES AND CUTTING OILS

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New API Booklet Explains Service Classifications

A booklet which explains the new API service classifications and designations for motor oils is now off the press and being made available to the petroleum and automotive industries, the Division of Marketing of the American Petroleum Institute has announced.

The new service classifications are the result of months of intensive study and work by the Division's Lubrication Committee. They were designed to streamline the new designations and bring them in line with the many improvements in motor oil in recent years.

The booklet points out that the new system of classifications will be of direct benefit to the public because it "provides a more logical basis for selecting the right oil for any engine under any service condition, and affords greater opportunity for the development of better oils to meet specific service conditions without regard to other requirements." It adds:

"This will contribute to better engine performance, longer engine life and greater safety at reduced maintenance costs."

For the dealer, the booklet continues, "the new system will enable him to explain more clearly to customers which oil is best suited to their individual engines and service conditions. This will mean more satisfied customers for him."

Ten pages long and four by nine inches in size, the booklet is priced as follows: in lots of 1000—$47 per thousand, FOB Baltimore; in lots of 500—$25 per 500, FOB Baltimore; in lots of 100—$6.00 per hundred, postpaid; in lots of 14—$1.00 per 14, postpaid.

Orders may be placed through the Division of Marketing, 1625 K Street, NW, Washington, or the American Petroleum Institute, 50 West 50th Street, New York 20, N. Y.

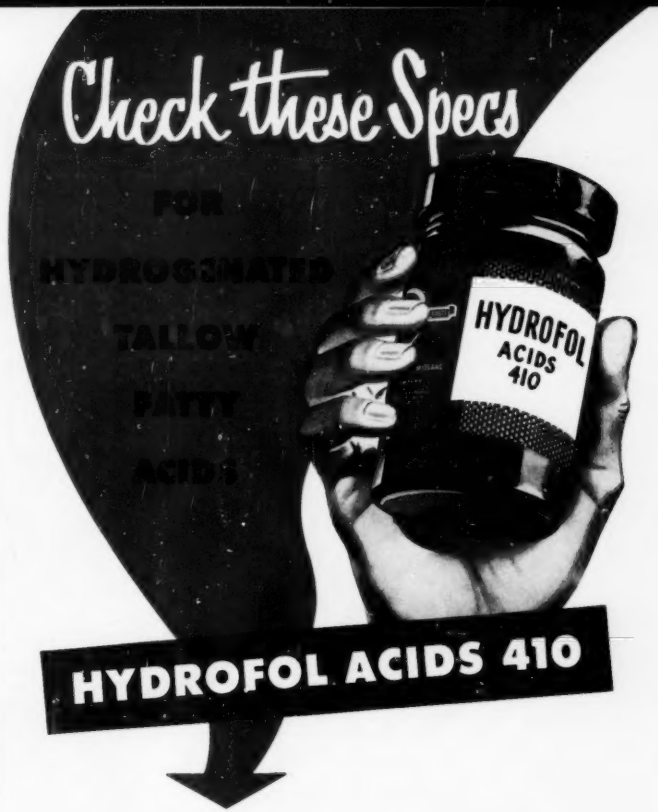
OIIC National Chairman Announced for 1953

Stanton K. Smith, president of Smith Oil & Refining Co., Rockford, Ill., will be the national chairman of the Oil Industry Information Committee in 1953.

Mr. Smith, who will succeed Charles Z. Hardwick, vice-president of The Ohio Oil Co., Findlay, Ohio, was elected to the chairmanship at a meeting of the committee in Chicago.

He will take office January 1.

Philip C. Humphrey, manager of pub-



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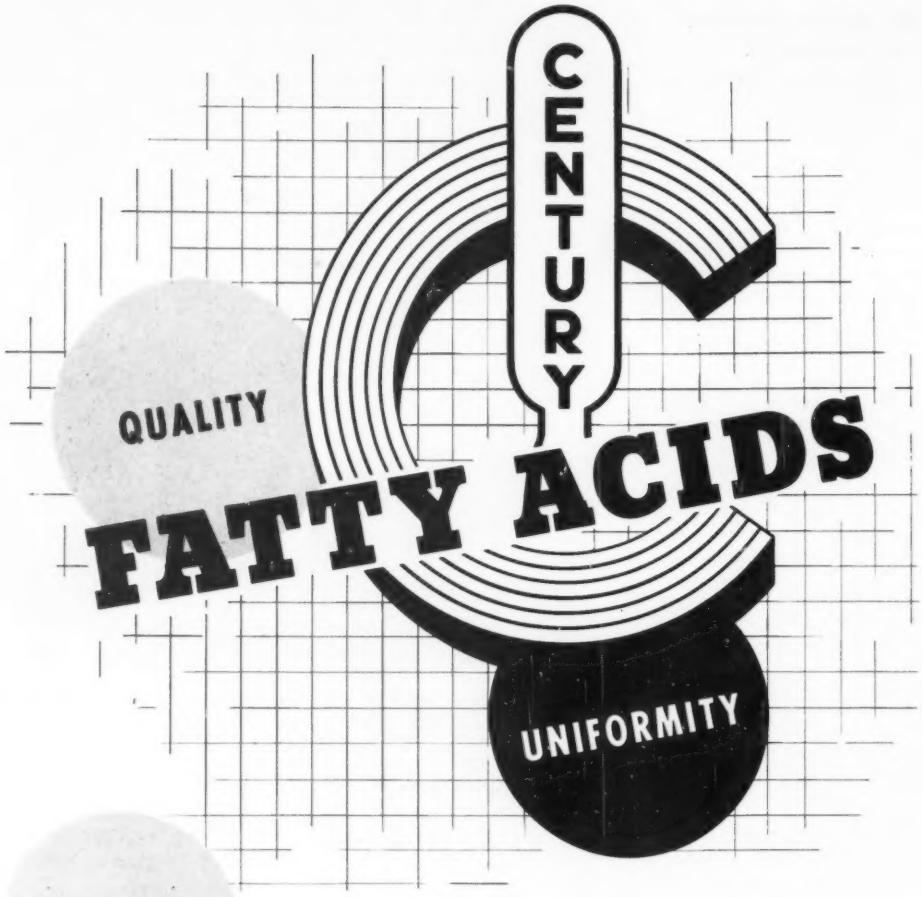

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There's a grade of Century Stearic to meet your precise requirements for metallic soaps as well as lubricating greases. Triple pressed where superior color and stability are needed; double or single pressed where economy plus efficiency is necessary.

CENTURY OLEIC ACID

From regular red oil to low-titer white Oleic Acid—for greases, additives, rust preventatives, etc., there's a Century Oleic Acid to meet your needs **exactly**. Century Oleic Acids are the standard of the industry because of their high quality and uniformity.

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lic relations, The Texas Company, New York, and William N. Finnegan, Jr., assistant to the president, Humble Oil & Refining Co., Houston, Texas, were re-elected vice-chairmen.

Two new vice-chairmen named were W. J. Loufman, president of Fleet Wing Corp., Cleveland, Ohio, and C. Haines Finnell, director of public relations and advertising, Union Oil Company of California, Los Angeles.

John S. Cooke, of Hoboken, N. J., was re-elected secretary for the sixth consecutive year.

Mr. Smith has been active in the work of the Oil Industry Information Committee since its inception. He was the first state chairman in Illinois, and was appointed to the national committee in 1947. He has served two terms as a vice-chairman.

'Chemonomics' Discusses European Information

The staff of R. S. Aries & Associates, New York consulting firm of chemical engineers and economists, has gathered interesting information on new European chemical product and process developments during recent trips abroad. Projects in Switzerland, Austria, Belgium, England, France and Germany are discussed in the latest issue of the Aries house organ, CHEMONOMICS, which is just off the press.

If you would like to learn more about these and other developments in the chemical process industries, and if you are not already on the Aries mailing list, copies of CHEMONOMICS can be secured by writing to the firm at 400 Madison Ave., New York 17, N. Y.

Brown-Allen Chooses New York Sales Agent

Brown-Allen Chemicals, Inc., New York, announces the appointment of John H. Calo & Company, 19 Rector Street, New York, as Sales Agent for its oil and chemical products in the metropolitan New York area, effective October 10, 1952.

John H. Calo & Company represents Hercules Powder, Reynolds Metal and formerly was distributor for Brown Oil & Chemical Company.

Gray Co. Announces New, Low Cost Motor Oil Dispenser

A new bulk motor oil dispenser, called the Quart-O-Matic, that delivers one measured quart of oil at the touch of a button has been perfected by the Gray Company, Inc., 1015 Sibley Street, Minneapolis 13, Minnesota.

Very low in cost and completely new in idea and principle, the Quart-O-Matic is designed for cleaner, more efficient oil dispensing service. By eliminating hand cranking it delivers the desired quantities of oil without effort—completely obsoletes manually operated bulk dispensing pumps.

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FUTURE MEETINGS of The Industry

NOVEMBER, 1952

19 American Standards Association (34th annual meeting), Waldorf-Astoria, New York, N. Y.

25 American Socy. for Testing Materials (E-11 on Quality Control of Materials), Philadelphia, Pa.

25 American Socy. for Testing Materials (Northern California District), San Francisco, Calif.

30 to Dec. 5 American Socy. of Mechanical Engineers (annual meeting), Statler Hotel, New York, N. Y.

DECEMBER, 1952

1-3 New Mexico Oil and Gas Assn. (annual meeting), Alvarado Hotel, Albuquerque, New Mex.

1-6 20th National Exposition of Power & Mechanical Engineering, Grand Central Palace, New York, N. Y.

5-6 Interstate Oil Compact Commission (winter meeting), Allis Hotel, Wichita, Kansas.

7-10 American Inst. of Chemical Engineers (annual meeting), Hotels Cleveland and Carter, Cleveland, Ohio.

8-9 Chemical Specialties Mfrs. Assn. (39th annual meeting), Hotel New Yorker, New York, N. Y.

26-31 American Assn. for the Advancement of Science, Jefferson Hotel, St. Louis, Mo.

JANUARY, 1953

7-8 Kentucky Petroleum Marketers Assn. (annual meeting — trade show), Brown Hotel, Louisville, Ky.

12-16 Socy. of Automotive Engineers (annual meeting and engineering display), Sheraton-Cadillac Hotel, Detroit, Mich.

FEBRUARY, 1953

1-6 American Socy. for Testing Materials (Com. D-2 on petroleum products and lubricants), Hotel Cleveland, Cleveland, O.

3-5 American Socy. for Testing Materials (A-1 on Steel), Birmingham, Ala.

5-7 Missouri Petroleum Assn. (annual convention), Hotel President, Kansas City, Mo.

13 American Socy. for Testing Materials (Philadelphia District — National Officer's Night), Philadelphia, Pa.

16-18 American Petroleum Institute (Division of Marketing, Lubrication Committee meeting), Sheraton-Cadillac, Detroit, Mich.

18-19 Iowa Independent Oil Jobbers Assn. (annual convention), The Savery, Des Moines, Ia.

25-26 Wisconsin Petroleum Association, Hotel Schroeder, Milwaukee, Wisc.

26 to Mar. 1 Pacific Automotive Show, Civic Auditorium, San Francisco, Calif.

MARCH, 1953

2-6 American Socy. for Testing Materials (spring meeting), Hotel Statler, Detroit, Mich.

4-6 American Petroleum Institute (Division of Production, Southwestern district), The Blackstone, Ft. Worth, Tex.

8-11 American Inst. of Chemical Engineers, The Buena Vista, Biloxi, Miss.

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10-12 Illinois Petroleum Marketers Assn. (annual convention), Hotel Sherman, Chicago, Ill.

15-19 American Chemical Society (123rd national meeting), Hotels Biltmore and Statler, Los Angeles, Calif.

16-20 National Assn. of Corrosion Engineers (1953 conference and exhibition), Hotel Sherman, Chicago, Ill.

18-20 American Petroleum Institute (Division of Production, Mid-Continent District spring meeting), Mayo Hotel, Tulsa, Okla.

19-21 Texas Oil Jobbers Assn. Inc. (annual convention), The Plaza Hotel, San Antonio, Tex.

23-26 American Assn. of Petroleum Geologists—Socy. of Economics Paleontologists and Mineralogists—Socy. of Exploration Geophysicists (joint annual meeting), Coliseum, Houston, Tex.

25-27 Socy. of Automotive Engineers (national production meeting), Hotel Statler, Cleveland, Ohio.

APRIL, 1953

8-10 American Petroleum Institute (Division of Production, Eastern District spring meeting), Hotel William Penn, Pittsburgh, Pa.

13-15 American Socy. of Lubrication Engineers (annual meeting and exhibit), Hotel Statler, Boston, Mass.

13-15 Assn. of Nebraska Liquefied Petroleum Gas Dealers (annual convention), Hotel Fontenelle, Omaha, Neb.

15-17 National Petroleum Association (semi-annual meeting), Hotel Cleveland, Cleveland, Ohio.

20-22 American Petroleum Institute (Division of Transportation, products pipeline conference), Hotel Muehlebach, Kansas City, Mo.

26-29 American Inst. of Chemical Engineers (joint meeting with Chemical Institute of Canada), Royal York Hotel, Toronto, Canada.

27-28 Independent Petroleum Assn. of America (midyear meeting), Jefferson Hotel, St. Louis, Mo.

MAY, 1953

4-5 American Petroleum Institute (Division of Marketing, midyear meeting), Baker Hotel, Dallas, Tex.

4-6 Liquefied Petroleum Gas. Assn. (annual convention & trade show), Conrad Hilton Hotel, Chicago, Ill.

10-12 tentative Pennsylvania Petroleum Assn., Inc. (3-day meeting), Bedford Springs Hotel, Bedford Springs, Pa.

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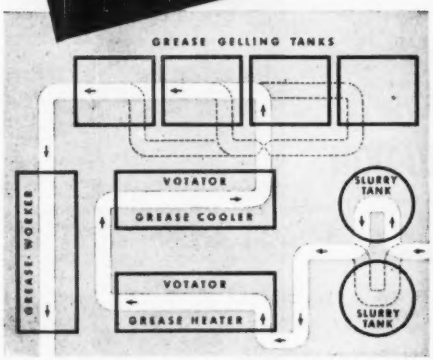

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FUTURE MEETINGS of The Industry

MAY, 1953

11-13 American Petroleum Institute (Division of Marketing, Lubrication Committee meeting), Greenbrier, White Sulphur Springs, West Va.

11-14 American Petroleum Institute (Division of Refining, 18th midyear meeting), Hotel Commodore, New York, N. Y.

11-15 National Fire Protection Assn. (annual meeting), Edgewater Beach Hotel, Chicago, Ill.

14-23 International Petroleum Exposition, Tulsa, Okla.

JUNE, 1953

2-3 American Petroleum Institute (Division of Production, Pacific Coast District spring meeting), Hotel Statler, Los Angeles, Calif.

7-12 Socy. of Automotive Engineers (summer meeting), The Ambassador and Ritz-Carlton, Atlantic City, N. J.

15-19 American Petroleum Institute (Division of Production, midyear committee conference), Hotel William Penn, Pittsburgh, Pa.

29 to July 3 American Socy. for Testing Materials (annual meeting), Chalfonte-Haddon Hall, Atlantic City, N. J.

AUGUST, 1953

17-19 Socy. of Automotive Engineers (national West Coast meeting), Georgia Hotel, Vancouver, B. C., Canada.

SEPTEMBER, 1953

6-11 American Chemical Society (124th national meeting), Conrad Hilton Hotel, Chicago, Ill.

13-16 American Inst. of Chemical Engineers, Fairmont and Mark Hopkins Hotels, San Francisco, Calif.

16 American Petroleum Institute (Division of Marketing, Lubrication Committee meeting), The Traymore, Atlantic City, N. J.

16-18 National Petroleum Assn. (51st annual meeting), The Traymore, Atlantic City, N. J.

21-23 American Trade Assn. Executives (annual meeting), Chalfonte-Haddon Hall, Atlantic City, N. J.

OCTOBER, 1953

19-20 Independent Petroleum Assn. of America (annual meeting), Hotel Texas, Ft. Worth, Tex.

19-23 National Safety Congress, Conrad Hilton, Congress, Morrison, Sheraton, Chicago, Ill.

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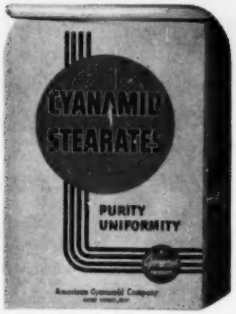

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